Honors General Chemistry
Chem 151
Fall 2016
Syllabus for the Lecture Material
(as of July 7, 2016, subject to revision)

Instructors

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Text

Chemical Principles, 7th Edition — Required — Atkins, Jones and Laverman

A student solutions manual for the text is available. It is recommended but not required.

Topics and Sequence

Unit I *Atomic Structure and Bonding*
- Chapter 1 The Quantum World
- Chapter 2: Quantum Mechanics in Action: Atoms
- Chapter 3 Chemical Bonds
- Chapter 4 Molecular Shape and Structure

Unit II *States of Matter*
- Chapter 5 The Properties of Gases
- Chapter 6 Liquids and Solids
- Chapter 7 Inorganic Materials

Unit III *Thermochemistry and Thermodynamics*
- Chapter 8 Thermodynamics: The First Law
- Chapter 9 Thermodynamics: The Second and Third Laws

A detailed listing of the topics covered in this course is found at the end of the syllabus.

Assignments

Students are responsible for reading the assigned material in the text before coming to class and are expected to participate in discussion of that material during class.

Homework will be assigned weekly and will usually be due on Wednesdays; however, due dates may be changed to match the pace of the course material. Students are allowed to consult with the discussion leader and other students in working homework assignments although certain assignments or parts of assignments may be pledged. Students may not, however, consult with homework sets or solutions from previous years. Any assignment or part of an assignment to be pledged will be clearly indicated.

Occasionally there are printing errors in any textbook. If you have questions about the accuracy of a given exercise, please consult with Prof. Whitmire.

Class attendance is essential to good performance in the course. Material may be covered that is not found in the textbook, and different approaches from those used in the text may be presented. Students are responsible for getting any lecture notes and assignments that they may miss due to class absences from their colleagues or from the posted class notes. Any material covered in class or in the reading may appear in examination questions!

Exams

There will be three unit exams during the semester and one comprehensive final exam. Each exam except the final exam will be take-home. All exams are closed-notes, closed-book and pledged. Fundamental constants and data required for working the problems will be provided. You may not consult any resources outside your own brain for help on the exams unless indicated on the instruction sheet for the exam. Exams will have time limits of 2 – 3 hours. Because of the way holidays fall in the fall semester, some material will be covered *after* the third unit exam. This material will be included in section 3 on the final exam.

The unit exams will be distributed in class and collected on the days indicated in the table. These dates may be revised depending on circumstances. A penalty will be assessed for turning in the exam late. There will be no makeup exams. You have the opportunity to make up for missing an exam or for poor performance by earning redemption points on the final exam (see below).

The final examination will be three hours in length (closed-notes and closed book) and will be scheduled by the Registrar who will announce the date later during the semester (the posted date for publication of the final exam schedule is the end of September). The final examination will be given only during that time slot. Alternate times for those wishing to leave early for break will not be made, so **do not buy plane tickets until the final exam schedule is announced**!

Exam	Tentative Material Covered	Tentative Distribution Date	Tentative Due Date
Exam 1	Unit I (Chapts. 1-4)	Friday, September 23	Wednesday, September 28
Exam 2	Unit II (Chapts. 5-7)	Friday, October 21	Wednesday, October 26
Exam 3	Unit III, (Chapts. 8-9)	Friday, November 18	Tuesday, November 22

Getting Help: Help Sections, Tutorials, etc.

You are encouraged to seek help in understanding class material. Office hours will be announced at the beginning of the semester.

Each student in CHEM 151 can attend is encouraged to attend the help section for the class. Time and place will be announced during the first week of classes. A discussion leader will be available to answer questions about class material and homework problems. Normally the sessions will last about an hour. But if student questions are resolved quickly the session may end early, so you should plan to show up at the beginning of a session. Sessions immediately before exams tend to last longer. The discussion leaders may also hold office hours at other times during the week depending upon demand and need.

Every residential college has a society of fellows from which you can request help. Each college is different. They may have organized office hours and review sessions or you may be able to request individual help.

Grading

Your course grade will be determined from the sum of your scores on the lab, homework, and exams according to the following scheme:

Homework	100 pts	
Exams	450 pts	(3 @ 150 points each)
Lab	250 pts	
Final Exam	200 pts	
TOTAL	1000 pts	

All homework assignments will be *approximately* the same value and will be normalized to a total of 100 points at the end of the semester.

Attendance and participation in class and discussion section will be considered in making final grade determinations. The performance of students at grade cut-offs will be discussed by the instructors and the discussion leaders and lab assistants to determine if the student's effort merits the higher grade designation. It is thus to your advantage to make yourself known to your instructor and discussion leader. Grades of A+ will be assigned based upon exceptional and distinguished performance in all aspects of the class and not upon the point totals for the class.

Grades will be based upon the point ranges given in the table below. The grade scheme is not comparative or competitive: that is, there is no "curve". You can argue the merits of curves if you wish; but in fact there is no need for a curve in this class. Students who apply themselves diligently should have no trouble earning A's and B's.

A	950 - 1000
A-	900 - 949
B+	850 - 899
B	790 - 849
B-	720 - 789
C+	626 - 719
C	610 - 625
C-	550 - 609
D	500 - 549
F	0 - 499

Redemption points

On the final exam, you will have the opportunity to earn "redemption points" for any points lost on the semester exams. Thus, you will have a second chance to demonstrate your understanding of the great majority of the material. The final exam will be comprehensive and composed of sections that correspond to the material tested in each unit exam. If you perform better on a section of the final exam than you did on the corresponding unit exam, your unit exam grade will be replaced by that higher score (calculated as a percentage). For example, if you scored 85% on the first exam and earn 90% of the points in section one of the final exam, your first unit exam grade will be changed to 90%. Please note that the study of chemistry builds upon itself, so material in later sections is likely to require an understanding of the material covered earlier in the course. It may also be a matter of choice as to which section a problem belongs.

CAUTION: Redemption points are both a blessing and a curse. They help you if you get into a bind with an exam, but it would be really difficult to rely completely on the final exam to get a good grade. Cramming at the last minute usually does not work for this material. Try to use redemption to go from a B to an A, not from a D or an F to an A. Most people don't earn as many redemption points as they think they will, and doing better on a particular section on the final requires a significant effort. It would be foolish to put all of your eggs in one basket (i.e., the final exam). REMEMBER: Redemption from ignorance is a lot easier than redemption from stupidity. Also, there is no redemption for homework grades.

Accommodations of Disabilities

If you have a documented disability that will impact your work in this class, *please contact Professor Whitmire during the first two weeks of class* to discuss your needs. This information will be kept confidential. Additionally, you will need to register with the Disability Support Services Office in the Ley Student Center if you have not done so already.

Chem 151 and Chem 121

It is possible to switch between CHEM 121 and CHEM 151 during the first weeks of class. If you feel that you are in the wrong course, please discuss switching with Professor Whitmire before making such a move so that your choice may be made in an informed manner. CHEM 121/122 and CHEM 151/152 are considerably different in course sequence. You should plan to take a consistent series in order to avoid gaps and duplication in material covered. If you do decide to switch between these courses, you must also switch your laboratory assignments (CHEM 153/123) as the laboratories are different for the two sequences.

Detailed List of Topics Covered in this Course

- A conceptual framework for atomic structure including the parts of the atom, atomic mass, isotopes, etc.
- Atomic processes and properties including ionization potentials, electron affinity, electronegativity, etc.
- Development of an in depth electronic structure of atoms and the fundamentals of quantum mechanics including a discussion of the experimental observations that led to its development including photoelectron spectroscopy and the work function, the uncertainty principle, the Aufbau principle, Hund's rule, wave-particle duality of nature, the probabilistic nature of electron motion, etc.
- Basics of atomic wave functions, orbital structure and atomic numbers including the four quantum numbers used to describe them.
- Fundamentals of mass spectrometry and how the technique is used to identify atoms and molecules.
- Fundamentals of bonding between atoms at different levels of theory: (1) electron sharing algorithms known as Lewis structures, and (2) valence bond theory which includes concepts of hybridization, and (3) simple molecular orbital diagrams.
- An introductory picture of how molecular orbital diagrams are developed and the fundamentals of how they are interpreted including bonding, antibonding and nonbonding orbitals, sigma orbitals, pi orbitals, and delta orbitals.
- An introductory description of photochemistry and oxidation-reduction processes as they relate to molecular orbital diagrams. Students will be able to predict the effect of moving electrons from one molecular orbital to another, to add or subtract electrons from a molecular orbital, and to calculate the overall bond order for a particular bond.
- Three-dimensional molecular structure will be discussed and students will be able to predict the geometrical structures for simple molecules based upon their Lewis structures.
- From Lewis structures and hybridization schemes, students will be able to predict bond angles and relative bond distances in simple molecules.
- Properties of gases will be examined by developing the kinetic molecular theory of gases, building upon the ideal gas law with studies of real gases, the van der Waals equation and interatomic and intermolecular interactions.
- Interatomic and intermolecular forces impact gas-phase, liquid-phase and solid state structure.
- Calculations involving changes in volume, pressure, temperature, and number of moles of gases using both ideal and real gas equations.
- Ideal gas relationships to follow extent of reaction and will apply these concepts to Dalton's law.
- Predict the relative order of magnitude of the different types of intermolecular interactions.
- Solid state structure, especially with respect to crystalline solids. This will include an understanding of close packing lattices and the fundamental structures of a variety of minerals and related chemical compounds.
- Fundamental properties of chemical compounds such as density, atomic distances, compound formulas, etc from their knowledge of crystal lattices and how atoms/molecules pack in solids.

- A basic understanding of conductivity as it relates to the electronic structure of conductors, semiconductors and insulators using a molecular orbital approach known as band theory. Understanding band gaps and how they may be tuned by doping the different types of semiconducting materials.
- Understanding of how energy is transferred in physical and chemical processes through thermochemistry and thermodynamics.
- Calculation of energy changes associated with phase transformations (solid, liquid, gas) as well as temperature changes that are not accompanied by a change in state (e.g., heat capacities).
- Standard states of elements and compounds and thermodynamic stability.
- Estimation of enthalpies of reactions by examining the nature and types of bonds broken and formed in a chemical reaction.
- Calculation of enthalpies of reaction from standard tables of thermochemical data such as enthalpies of formation, free energies of formation and entropies of chemical substances (Hess' Law calculations).
- Origin of tables of enthalpies of formation, free energies of formation and entropies.
- Fundamental data used to calculate lattice enthalpies.
- Spontaneity as it applies to chemical and physical processes as well as how spontaneity changes as reaction conditions change.
- Fundamental thermodynamic properties of chemical substances relate to current concerns in energy production and utilization.